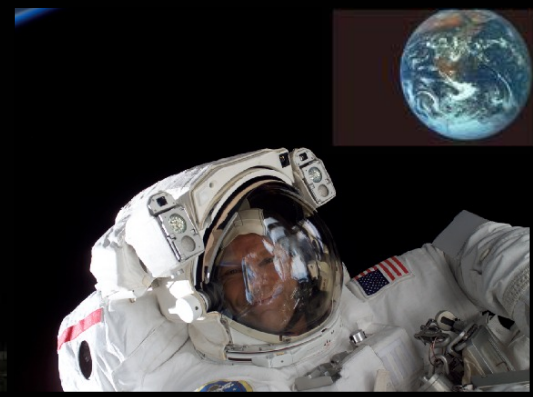


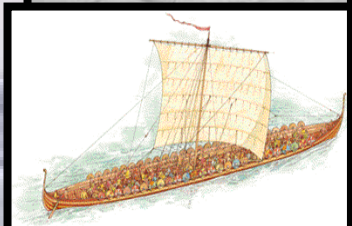




Human Challenges in Exploration Missions



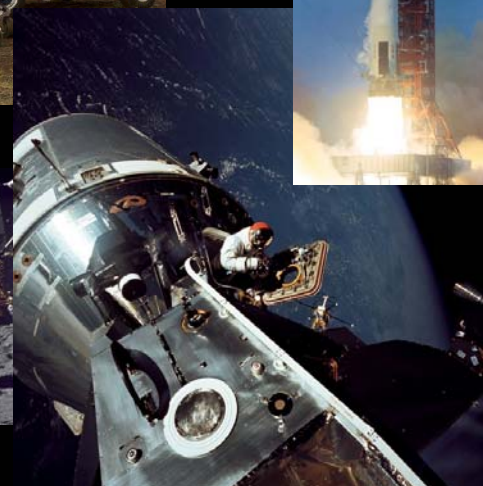




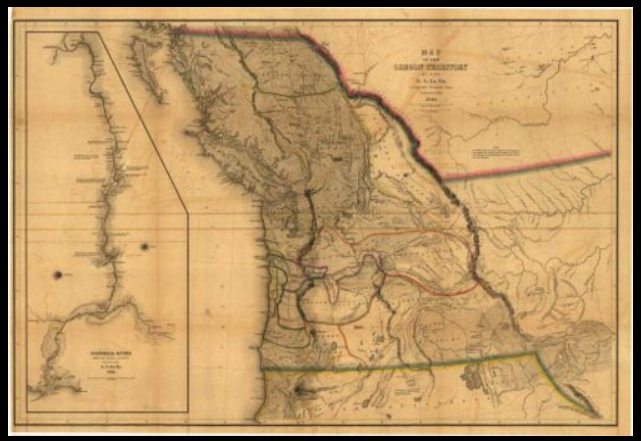




Space, the final frontier

http://www.marshome.org/images2/displayimage.php?pos=-1048



Past Exploration Missions

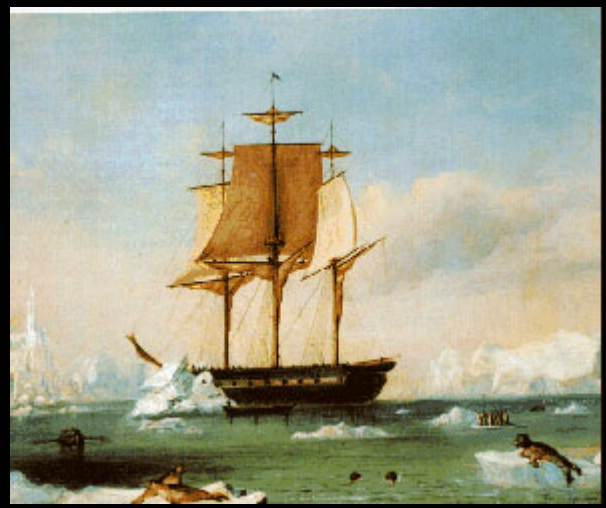


Map of Pacific Northwest

Henry Hudson

Celebration of Columbus' journey

The Gjoa-Edmundson's ship for the Northwest Passage voyage



The Vincenne, Wilkes' ship for discovery of Antarctica

Cheng Ho's voyages

How Do Explorers Travel?

Horseback

Space shuttle

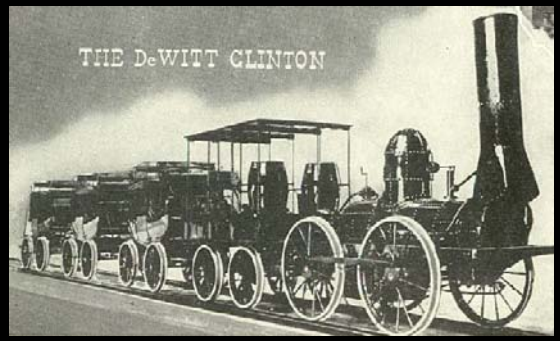
Lunar rover

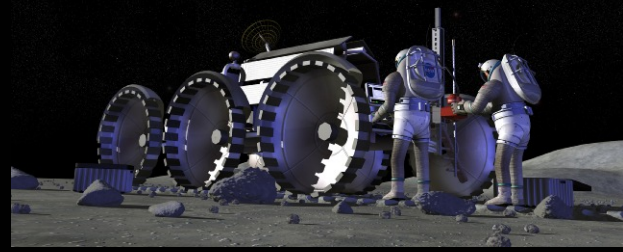
Foot

Ares and Orion

Saturn V

Wheels in the past, wheels in the future

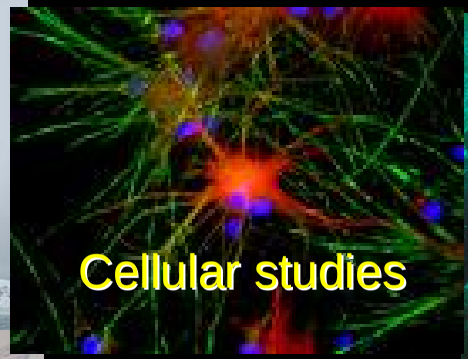




Current Earth Exploration Missions


Polar exploration


Extreme environments

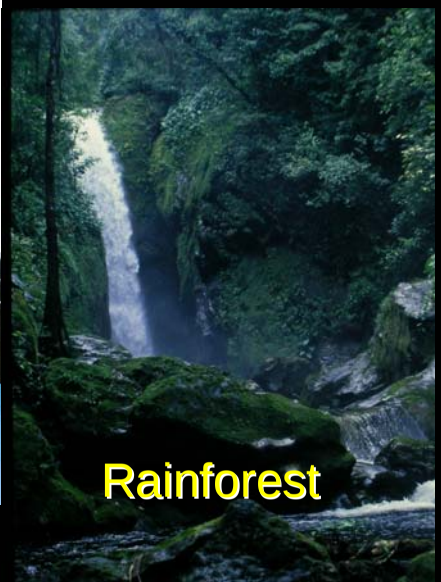

Cellular studies


Deep sea exploration


Scientific discovery


Earth's crust


Antarctica


Rainforest


Undersea habitats

What Challenges Facing Explorers Are the Same?

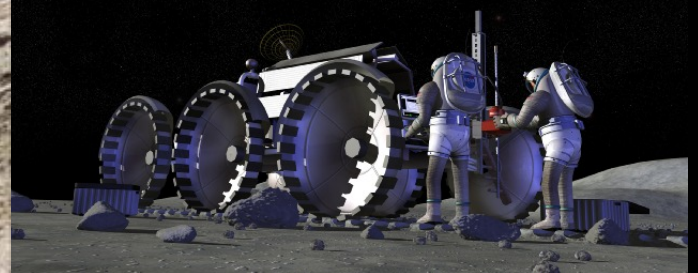
Basic needs:
- Food
- Water
- Air
- Shelter

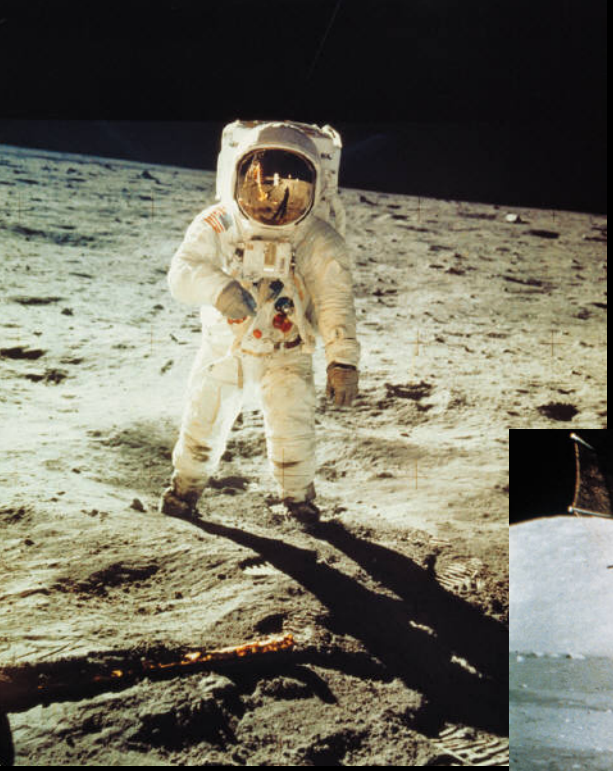
The unknown:
What will be there when we get there?

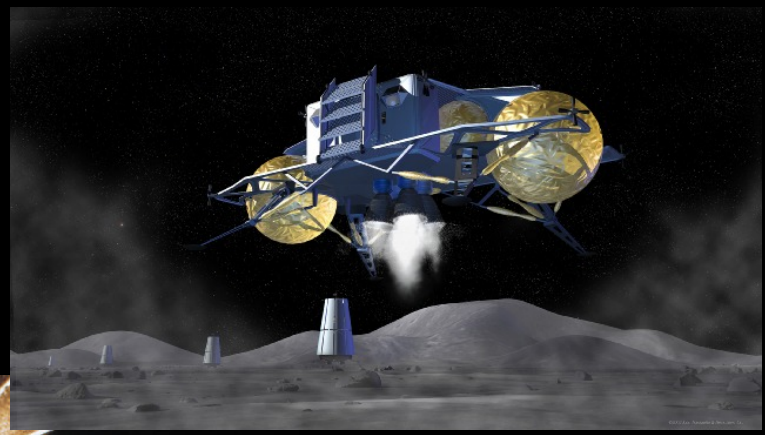
What will it be like?

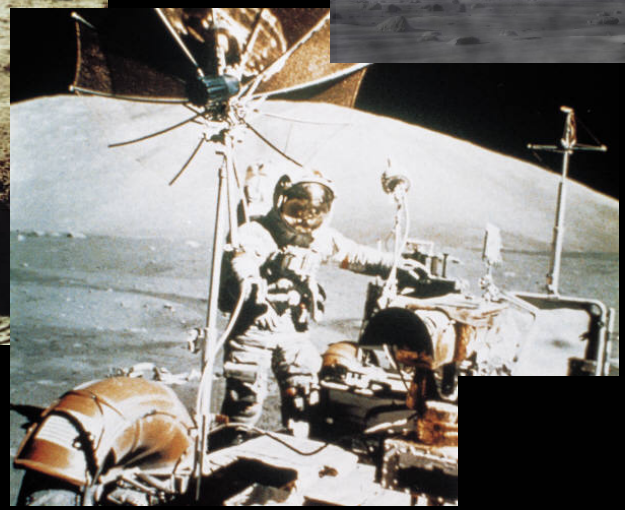
I am going to miss my friends

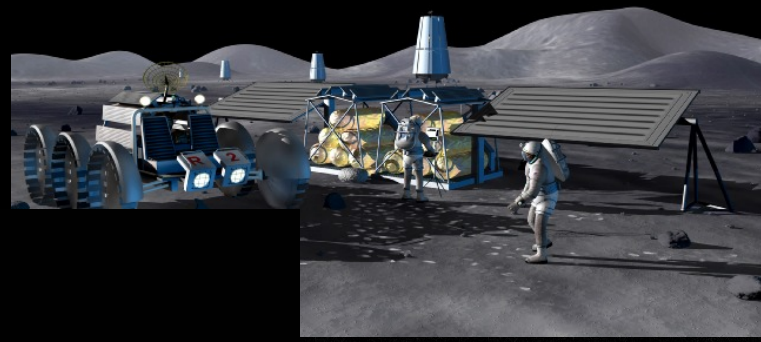
Transportation:
How do we get there?

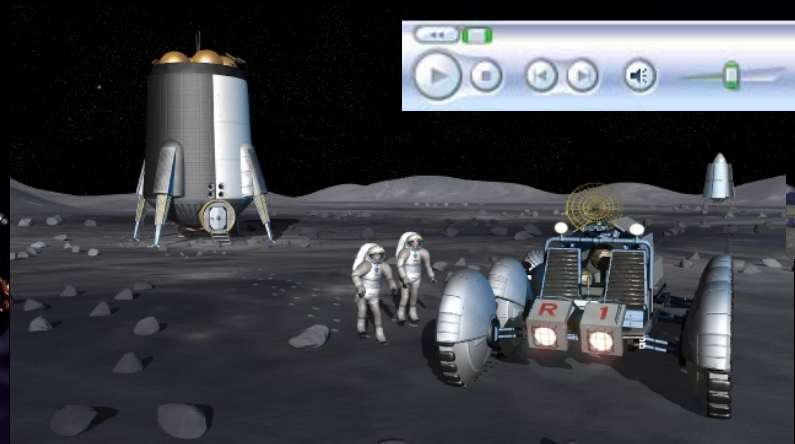


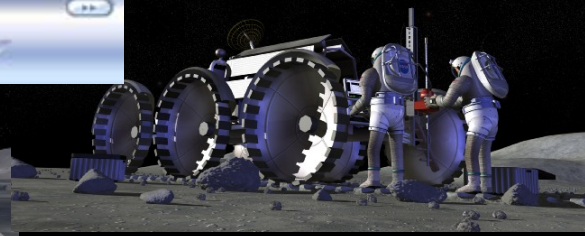




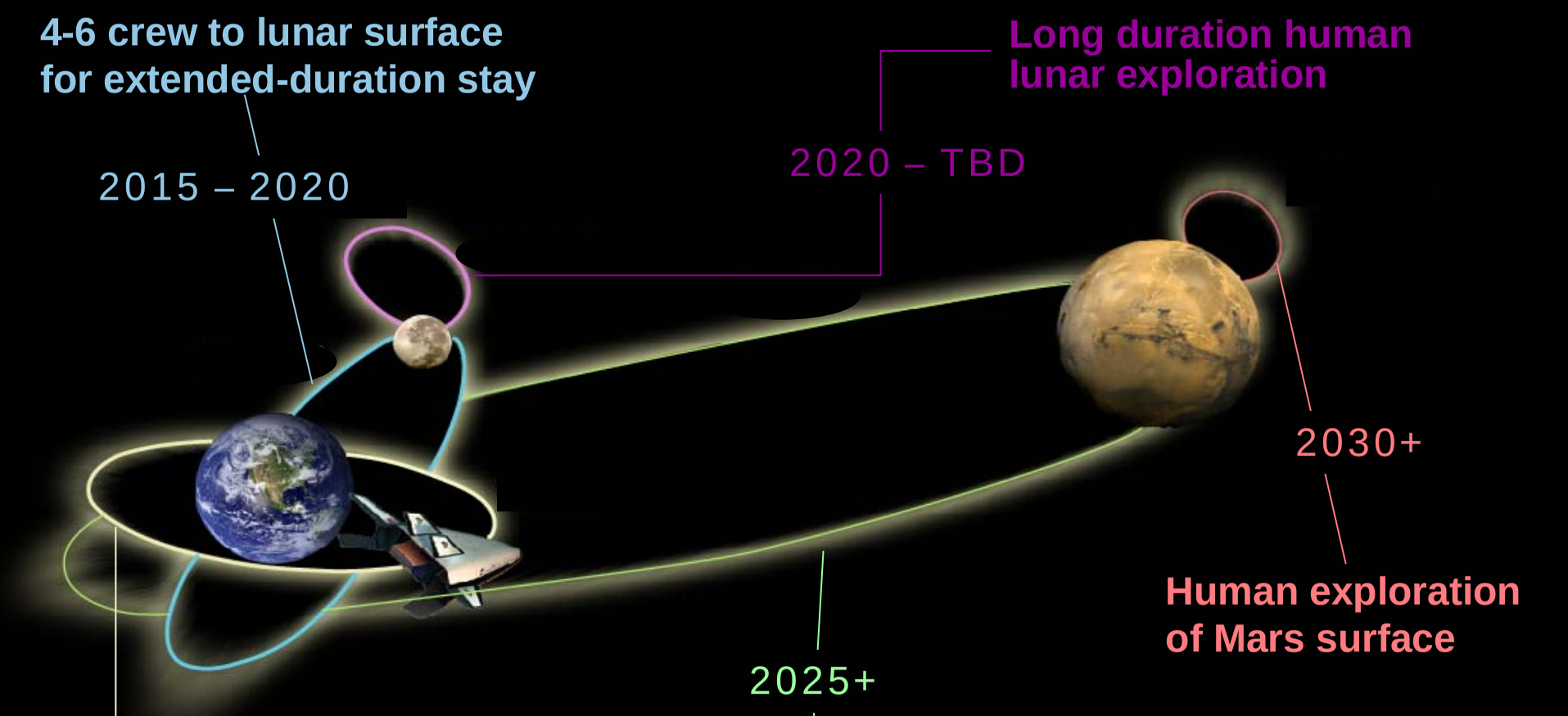








Exploration Timeline



4-6 crew to lunar surface
for extended-duration stay

2015 – 2020

Long duration human
lunar exploration

2020 – TBD

2030+

Human exploration
of Mars surface

2025+

Human exploration
to Mars vicinity

2008 – 2014

Transportation System to
Low Earth Orbit

NASA's Exploration Roadmap

1st Human
Orion Flight

05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

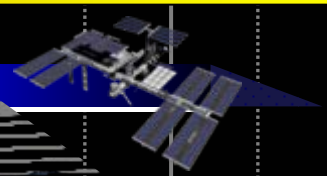
Initial Orion Capability

Lunar Outpost Buildup

Lunar Robotic Missions

Science Robotic Missions

Commercial Crew/Cargo for ISS

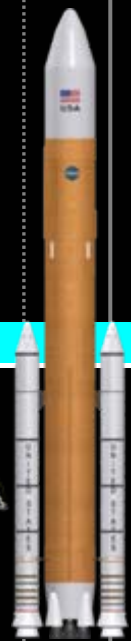


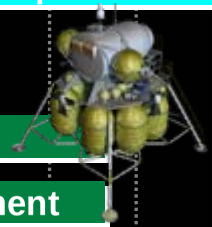
Space Shuttle Ops

Orion Development

Ares Development

Orion Production and Operations





Lunar Lander Development

Lunar Heavy Launch Development

Earth Departure Stage Development

Surface Systems Development

The Moon – the First Step to Mars and Beyond….

- Gaining significant experience in operating away from Earth's environment
  - **Space will no longer be a destination visited briefly and tentatively**
  - **"Living off the land"**
  - **Human support systems**

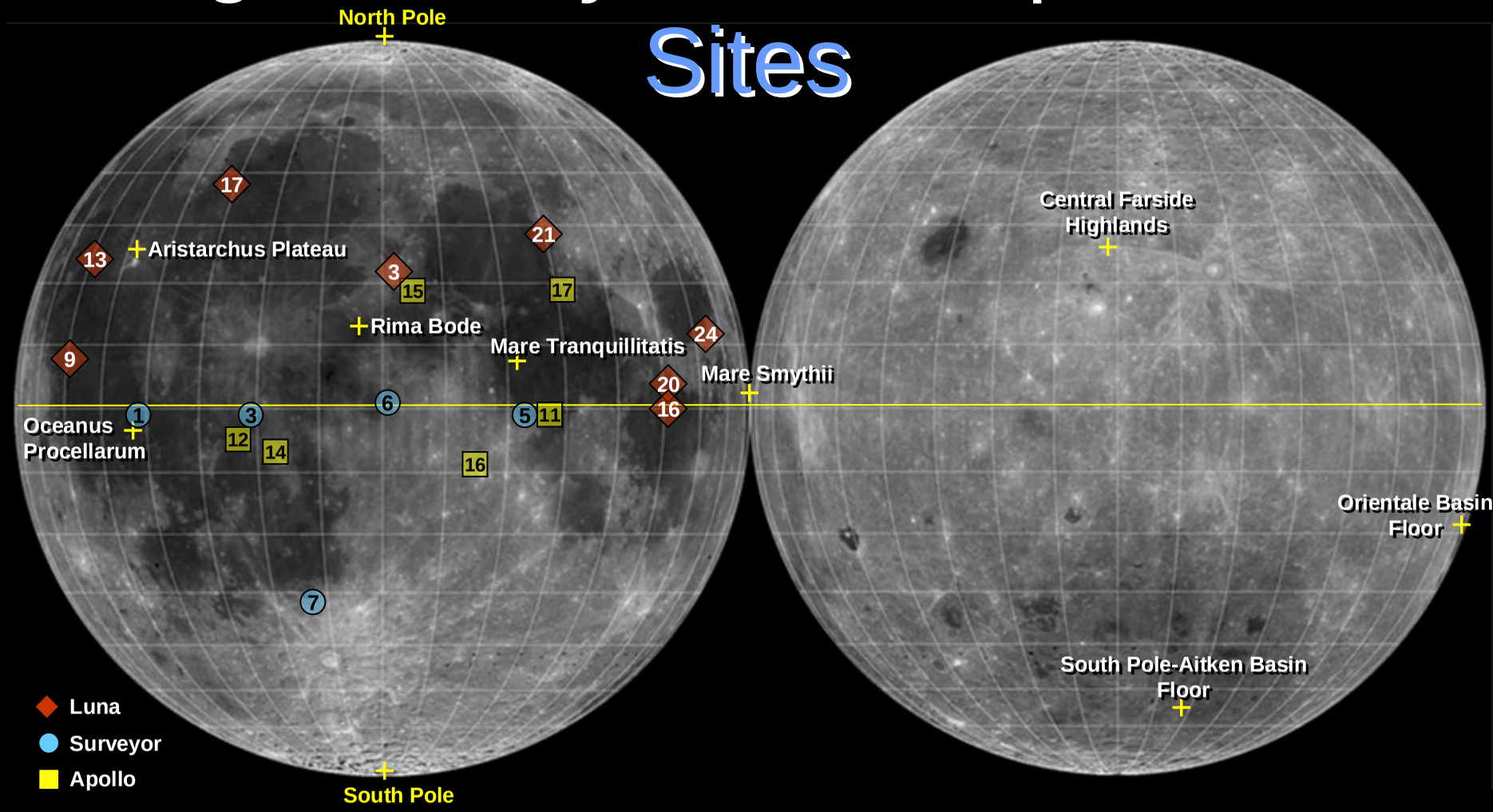
- Developing technologies needed for opening the space frontier
  - **Crew and cargo launch vehicles (125 metric ton class)**
  - **Earth ascent/entry system – Crew Exploration Vehicle**

- Conduct fundamental science
  - **Astronomy, physics, astrobiology, historical geology, exobiology**

Next Step in Fulfilling Our Destiny As Explorers

11

High Priority Lunar Exploration Sites

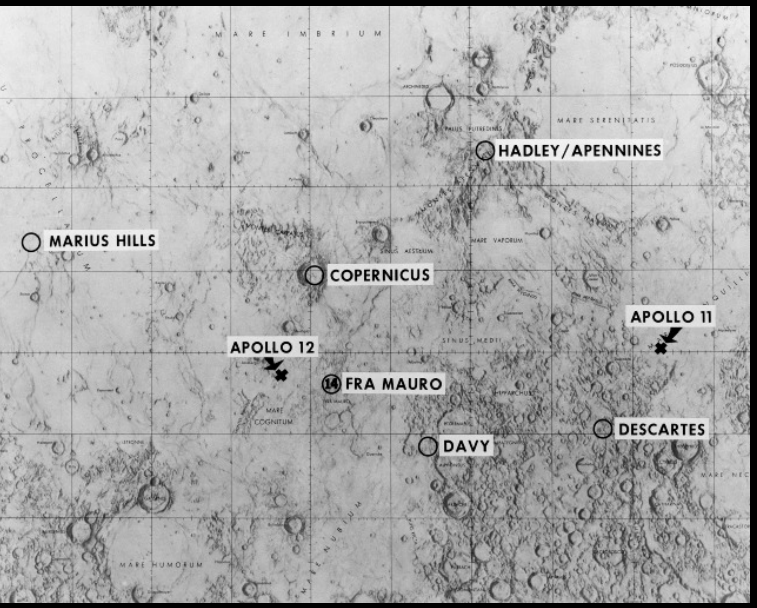


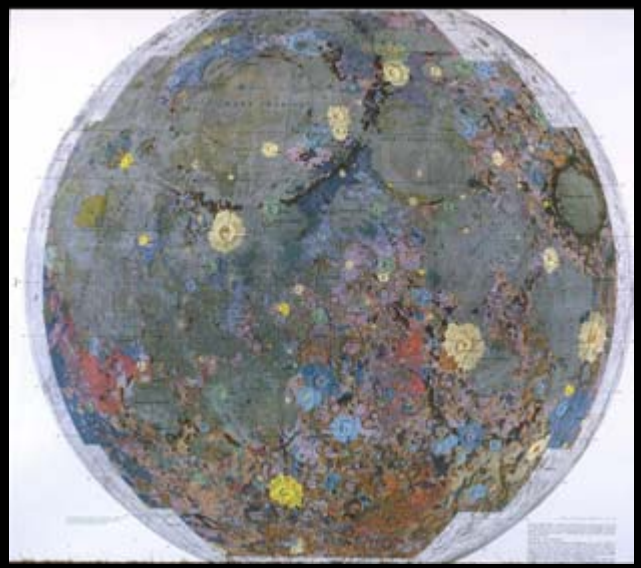
Near Side

Far Side

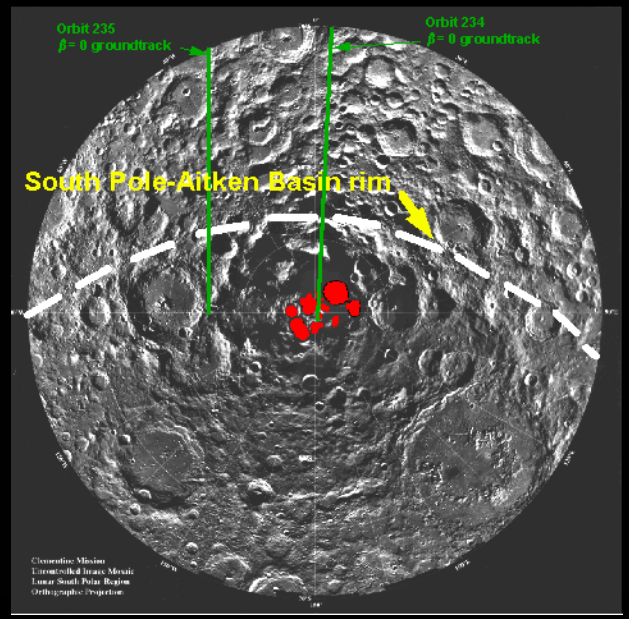
12

Moon Maps



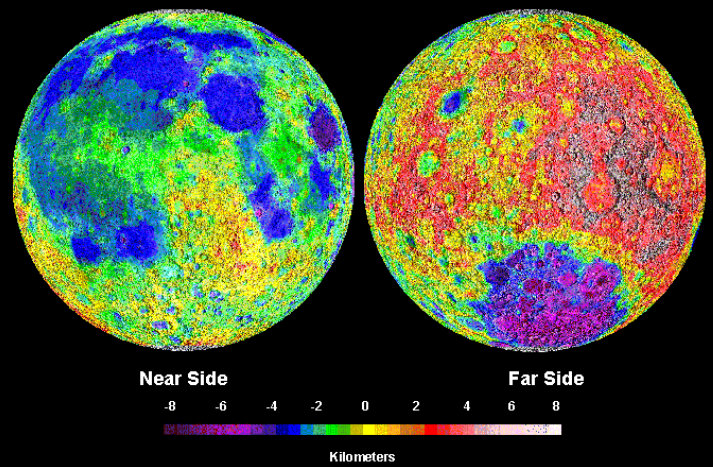


Clementine Map of the South Polar Region of the Moon



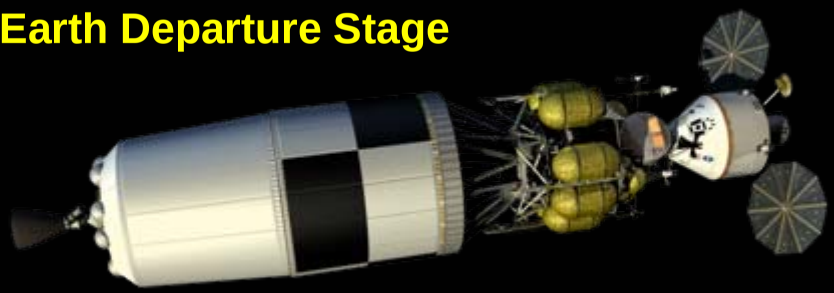
Clementine Topographic Map of the Moon

Contour Interval - 500 m



Components of Program Constellation

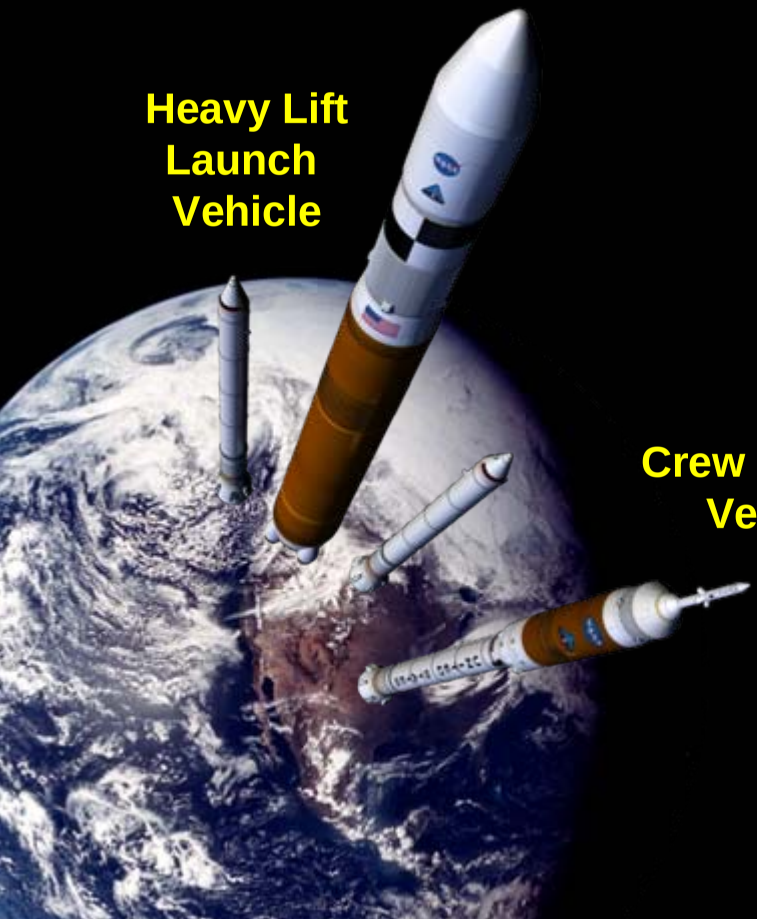
Earth Departure Stage



Orion - Crew Exploration Vehicle

Heavy Lift Launch Vehicle

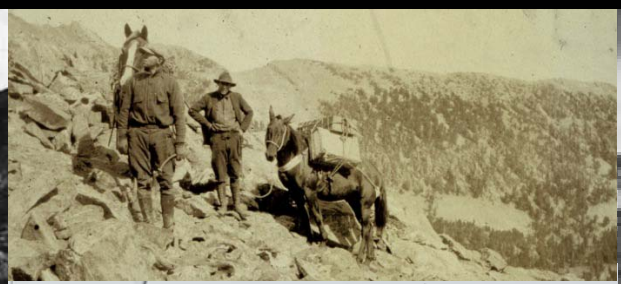
Crew Launch Vehicle



Lunar Lander

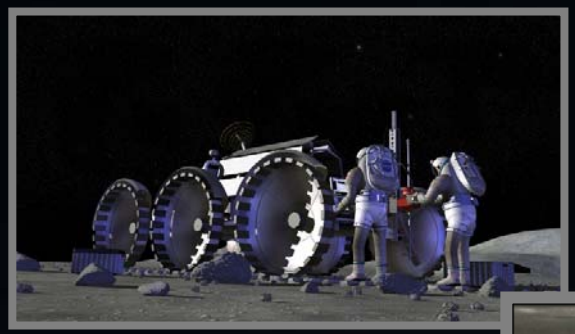
Frontier Life In History

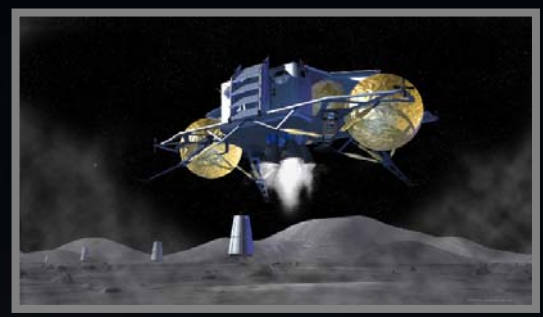
- Challenging physically, emotionally, and socially
- Frontier was the great unknown!
- In order to survive, one needed food, water, and shelter
- Had to bring everything they might need with them
- Without first explorers, discovery would have been impossible
- Explorers in history were important to the expansion of the human race



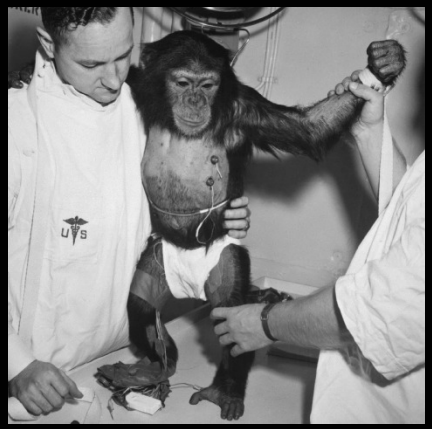
Frontier Life On The Moon

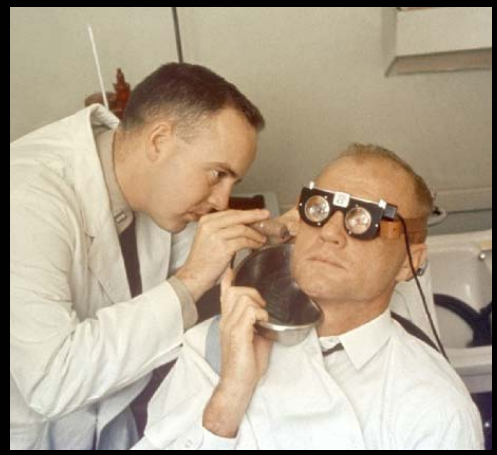
- Challenging physically, emotionally and socially
- The lunar frontier is the great unknown!
- In order to survive, space explorers will need food, water, shelter, and air
- Our lunar explorers will need to bring everything they'll need with them
- The explorers will set up habitat missions, science missions, & commercial ventures
- Future generations will use the knowledge gained from these initial mission to journey through out the galaxy





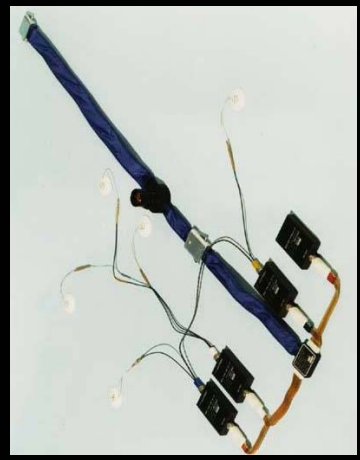
History of Space Life Science



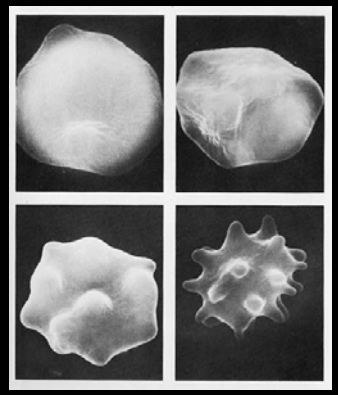


Gemini Project

Mercury Project



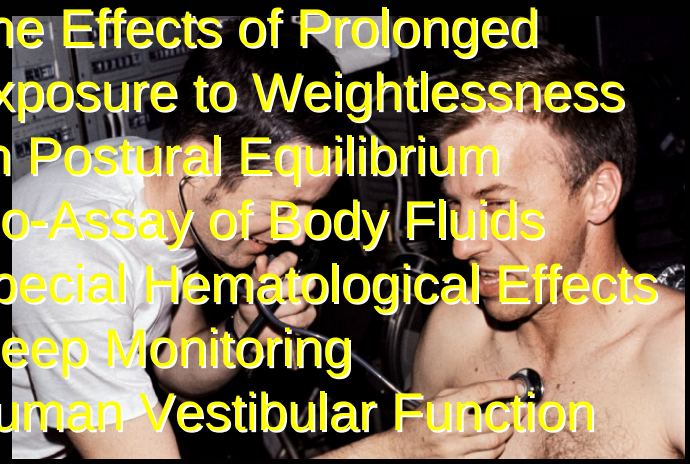
Apollo Space Life Science



- Cardiovascular evaluations
- Vestibular assessment
- Light flash investigations
- Radiation shielding and effects
- Clinical biochemistry
- Effects of cosmic rays
- Endocrinology, electrolyte and fluid volume assessment
- Exercise response
- Hematology and immunology studies
- Metabolism and heat dispersion during EVA
- Microbial responses
- Nutritional studies
- Skeletal response

Skylab Space Life Science

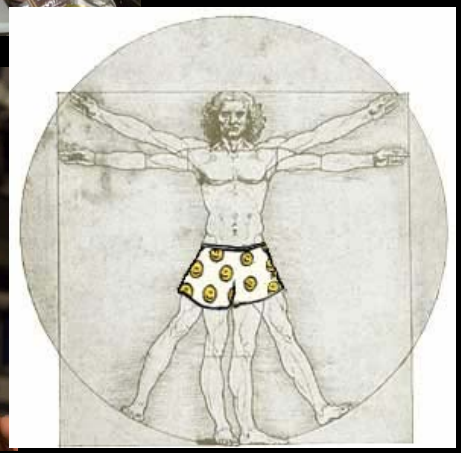
- Muscular De-conditioning and its Prevention
- Radiological Protection and Medical Dosimetry
- Microbiology Studies
- Immunity In-vitro
- Pulmonary Function and Evaluation
- Bone Mineral Measurement
- The Effects of Prolonged Exposure to Weightlessness on Postural Equilibrium
- Bio-Assay of Body Fluids
- Special Hematological Effects
- Sleep Monitoring
- Human Vestibular Function



Stressors

Sensory perception

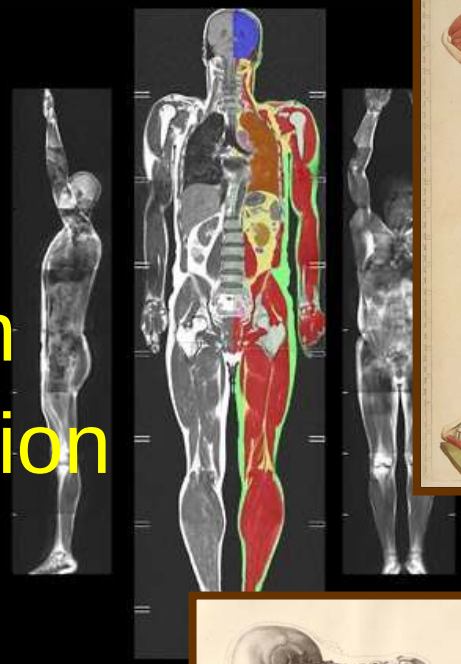
Stressors

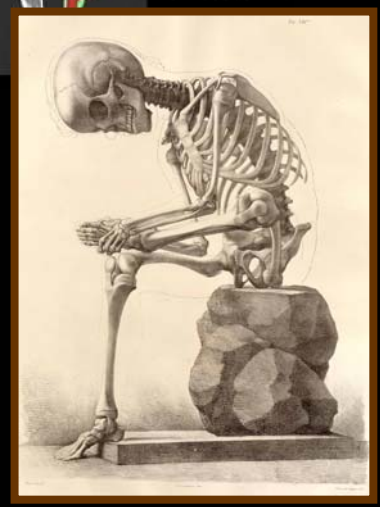


- Gravity effects on the Body - Adaptation (bone and muscle loss, alterations to the immune system, changes in cardiac function)
- Isolation effects on interpersonal behavior, changes in the immune system
- Radiation effects on human systems (immune, eyes), effects on food and medications, effects on instruments
- Light/Dark cycle impacts on circadian rhythm, change in sleep habits overall performance

Space & the Human Body

- Atrophy of muscles
- Loss of bone mass
- Changes in blood volume and cardiovascular system
- Issues with food and nutrition
- Changes in the immune system
- Changes in balance, hand-eye coordination
- Exposure to radiation



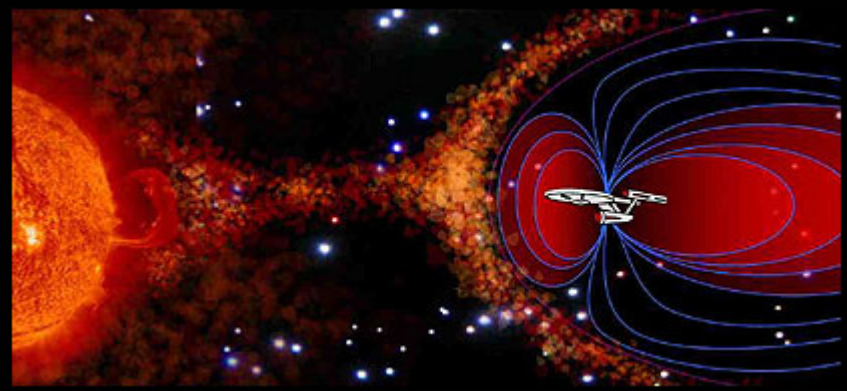


Human Factors-Behavior and Performance

- Isolation from family
- Sleep & workload
- Social interaction
- Psychological well-being
- Privacy and personal space
- Recreational activities

Environmental Factors Effecting Humans in Space

- Clean water
- Nutritious food
- Breathable air
- Acceptable noise and vibration limits
- Exposure to radiation



Medicine and Human Health in Space

- Medical support
- Health assessments
- Exercise
- Personal hygiene
- Stability of pharmaceuticals

As I stand out here in the wonders of the unknown at Hadley, I sort of realize there's a fundamental truth to our nature, Man must explore . . . and this is exploration at its greatest.

~Dave Scott, Commander Apollo 15, upon becoming the 7th man to walk on the Moon, 31 July 1971.